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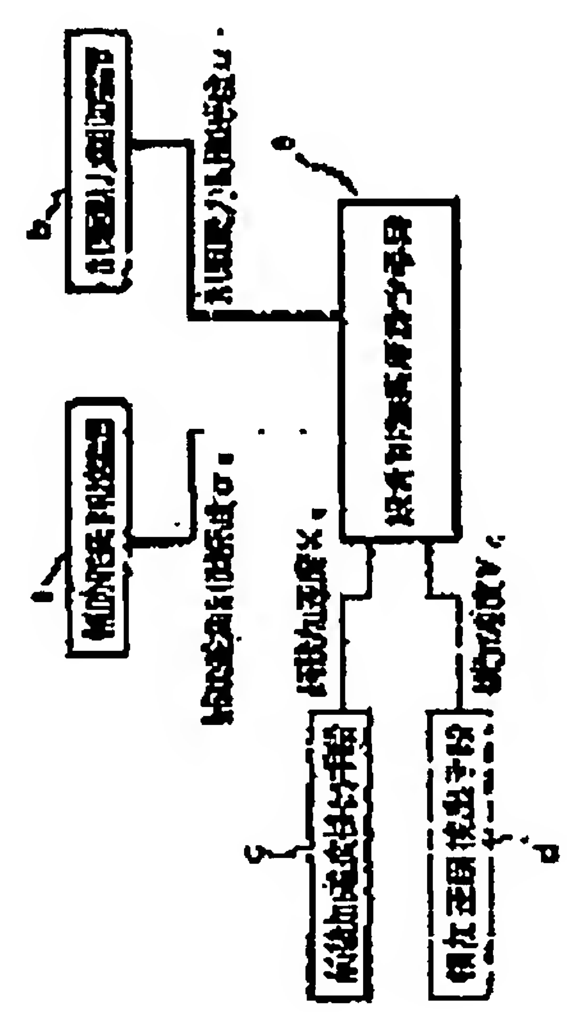
(54) INTEGRATED CONTROL DEVICE FOR AUXILIARY STEERING ANGLE AND BRAKING/DRIVING FORCE

(57)Abstract:

PURPOSE: To make the total control effect of both control devices optimum in a vehicle provided with an auxiliary steering angle control device and a braking/driving force control device simultaneously mounted thereon by discriminating vehicle state regions from each other by parameters including longitudinal acceleration, and changing control sensitivity according to the grade of control effect.



CONSTITUTION: An integrated control device is provided with an auxiliary steering angle control device (a) for controlling the steering angle of at least one of front wheels and rear wheels at the time of steering the front wheels, and a braking/driving force control device (b) for controlling at least one of the braking force and driving force of each wheel, respectively mounted on a vehicle. The integrated control device is further provided with a longitudinal acceleration detecting means (c) for detecting the longitudinal acceleration XG acting upon the vehicle. The auxiliary steering angle control sensitivity αs and the braking/driving force control sensitivity αT are then set by an integrated control sensitivity setting means (e) so as to enlarge the braking/driving force control sensitivity αr relatively to the auxiliary steering angle cotnrol sensitivity αs as the longitudinal acceleration detection value increases. The total control effect of both control devices a, b is therefore made optimum while preventing the control quantity of the device, having a larger control

effect during the simultaneous operation of both control devices a, b, from being limited.

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CLAIMS

(57) [Claim(s)]
[Claim 1] The auxiliary rudder angle control unit which controls one [at least] rudder angle of a front wheel or a rear wheel at the time of front-wheel steering, When the value multiplied by the amount of basic control is defined as control sensibility by the braking/driving force control unit which controls either [at least] the damping force of each ring, or driving force, the acceleration detection means before and after detecting acceleration before and after acting on a car, and the operation expression which obtains a target controlled variable, When the value of an order acceleration detection value is small, braking/driving force control sensibility is greatly set up for auxiliary rudder angle control sensibility small. The comprehensive control unit of an auxiliary rudder angle and braking/driving force characterized by having a comprehensive control sensibility setting means to make auxiliary rudder angle control sensibility small, and to set up braking/driving force control sensibility greatly as the value of an order acceleration detection value becomes large.
[Claim 2] The auxiliary rudder angle control unit which controls one [at least] rudder angle of a front wheel or a rear wheel at the time of front-wheel steering, The braking/driving force control unit which controls either [at least] the damping force of each ring, or driving force, When the value multiplied by the amount of basic control is defined as control sensibility by the acceleration detection means before and after detecting acceleration before and after acting on a car, lateral acceleration detection means to detect the lateral acceleration which acts on a car, and the operation expression that obtains a target controlled variable, Calculate the sum of the square of an order acceleration detection value, and the square of a lateral acceleration detection value, and when the operation value of the sum of a square is below a predetermined value While setting auxiliary rudder angle control sensibility as big constant value, when braking/driving force control sensibility is set as small constant value and the operation value of the sum of a square exceeds a predetermined value Calculate the ratio of an acceleration detection value before and after receiving a lateral acceleration detection value, and when the value of the calculated ratio is small, braking/driving force control sensibility is greatly set up for auxiliary rudder angle control sensibility small. The comprehensive control unit of an auxiliary rudder angle and braking/driving force characterized by having a comprehensive control sensibility setting means to make auxiliary rudder angle control sensibility small, and to set up braking/driving force control sensibility greatly as the value of the calculated ratio becomes large.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
(Field of the Invention)
This invention relates to the comprehensive control unit of an auxiliary rudder angle and braking/driving force.
(Prior art)
The contents which the equipment indicated by JP,59-77968,A, for example as a rear wheel rudder angle control unit which is an example of a former and auxiliary rudder angle control unit is known, **** a rear wheel to opposition when [this] the time of the low vehicle speed or a front-wheel steering angle is conventionally large to a source, **** a rear wheel to an inphase when the time of the high vehicle speed or a front-wheel steering angle is small, and raise controllability ability are shown.
Moreover, conventionally, as a driving force allocation control unit of the four-wheel drive car which is an example of a braking/driving force control unit, the equipment indicated by JP,61-157437,A is known, for example, the driving force allocation by the side of a coupled driving wheel is increased to a source at the time of driving wheel slip generating, conventionally [this], driving force allocation is controlled to a four-flower driving direction, and the contents which raise the drive engine performance and transit stability in the time of sudden start and acceleration etc. are shown in it.
(Object of the Invention)
By however, the case where the above-mentioned rear wheel rudder angle control unit and the driving force allocation control unit of a four-wheel drive car are carried in coincidence at one car Come out, respectively and rear wheel rudder angle control sensibility and driving force proportioning-control sensibility are set up uniquely. When it considers as the configuration which carries out mutually-independent based on setting sensibility, and performs rear wheel rudder angle control and a driving force proportioning control, Although the car condition field where the control effectiveness of auxiliary rudder angle control is big originally differs from the car condition field where the control effectiveness of braking/driving force control is big, since this point is not taken into consideration at all, the thing with the optimal total control effectiveness by both control units does not become.
Moreover, by the car in which two or more control units are carried in this way, when rear wheel rudder angle control and a driving force proportioning control are performed to coincidence, while a controlled variable turns into the same controlled variable as the case where it is carried independently even if it is in the small car condition of one control effectiveness and total energy expenditure serves as size, when consumption of total energy is restricted for the reasons of fuel consumption etc., the controlled variable of a side with the large control effectiveness may be restricted.
Then, although it can consider carrying out cooperative control, or performing control with which parts for other performance degradation are compensated by one control modification, and making mutual control link in order to only raise a certain engine performance, in this case, only to the specific engine performance, effectiveness does not pass to be obtained and cannot attain optimization of the total control effectiveness.
This invention was made paying attention to the above problems, and it makes it a technical problem to attain optimization of the total control effectiveness by both control units in the comprehensive control unit of the car with which the auxiliary rudder angle control unit and the braking/driving force control unit were carried in coincidence, preventing that a controlled variable is restricted by the large equipment side of the control effectiveness at the time of coincidence actuation of both control units.

(The means for solving a technical problem)
In order to solve the above-mentioned technical problem, it considered as a means to distinguish the car condition field where the control effectiveness of auxiliary rudder angle control is big, and the car condition field where the control effectiveness of braking/driving force control is big with the same parameter which contains order acceleration at least, and to change control sensibility according to the size of the control effectiveness at the comprehensive control unit of the auxiliary rudder angle of this invention, and braking/driving force.
As shown in the Fig. corresponding to the claim of Fig. 1 , namely, in invention according to claim 1 The auxiliary rudder angle control unit a which controls one [at least] rudder angle of a front wheel or a rear wheel at the time of front-wheel steering The braking/driving force control unit b which controls either [at least] the damping force of each ring, or driving force When the value multiplied by the amount of basic control is defined as control sensibility by the operation expression which obtains the acceleration detection means c before and after detecting the acceleration XG before and after acting on a car, and a target controlled variable, When the value of an order acceleration detection value is small, braking/driving force control sensibility alphaT is greatly set up for auxiliary rudder angle control sensibility alphaS small. It is characterized by having a comprehensive control sensibility setting means e to make small auxiliary rudder angle control sensibility alphaS, and to set up braking/driving force control sensibility alphaT greatly as the value of an order acceleration detection value becomes large.
Moreover, the auxiliary rudder angle control unit a which controls one [at least] rudder angle of a front wheel or a rear wheel by invention according to claim 2 at the time of front-wheel steering The braking/driving force control unit b which controls either [at least] the damping force of each ring, or driving force When the value multiplied by the amount of basic control is defined as control sensibility by the operation expression which obtains the acceleration detection means c before and after detecting the acceleration XG before and after acting on a car, a lateral acceleration detection means d to detect the lateral acceleration YG which acts on a car, and a target controlled variable, Calculate the sum (XG2+YG2) of the square of an order acceleration detection value, and the square of a lateral acceleration detection value, and when the operation value of the sum (XG2+YG2) of a square is below a predetermined value While setting auxiliary rudder angle control sensibility alphaS as big constant value, when braking/driving force control sensibility alphaT is set as small constant value and the operation value of the sum (XG2+YG2) of a square exceeds a predetermined value The ratio (alphaT/alphaS) of an acceleration detection value before and after receiving a lateral acceleration detection value is calculated. When the value of the calculated ratio (alphaT/alphaS) is small, braking/driving force control sensibility alphaT is greatly set up for auxiliary rudder angle control sensibility alphaS small. It is characterized by having a comprehensive control sensibility setting means e to make small auxiliary rudder angle control sensibility alphaS, and to set up braking/driving force control sensibility alphaT greatly as the value of the calculated ratio (alphaT/alphaS) becomes large.
 (work for)
When the value of an acceleration detection value when the value multiplied by the amount of basic control is defined as control sensibility by the operation expression which obtains a target controlled variable in the comprehensive control sensibility setting means e at the time of car transit if it is in invention according to claim 1, before and after detecting from the order acceleration detection means c is small, auxiliary rudder-angle control sensibility alpha S is set up greatly, and braking/driving-force control sensibility alpha T is set up small. And auxiliary rudder angle control sensibility alphaS is small set up as the value of an order acceleration detection value becomes large, and braking/driving force control sensibility alphaT is set up greatly.
Moreover, if it is in invention according to claim 2 at the time of car transit When the value multiplied by the amount of basic control is defined as control sensibility in the comprehensive control sensibility setting means e by the operation expression which obtains a target controlled variable, The sum (XG2+YG2) of the square of an order acceleration detection value and the square of a lateral acceleration detection value calculates, and when the operation value of the sum (XG2+YG2) of a square is below a predetermined value, while auxiliary rudder angle control sensibility alphaS is set as big constant value, braking/driving force control sensibility alphaT is set as small constant value. and when the operation value of the sum (XG2+YG2) of a square exceeds a predetermined value The ratio (alphaT/alphaS) of an acceleration detection value before and after receiving a lateral acceleration detection value calculates. When the value

of this calculated ratio (alphaT/alphaS) is small, auxiliary rudder angle control sensibility alphaS is set up greatly. Auxiliary rudder angle control sensibility alphaS is set up small, and braking/driving force control sensibility alphaT is greatly set up as braking/driving force control sensibility alphaT is set up small and the value of the calculated ratio (alphaT/alphaS) becomes large.

That is, although it considers as XG or (XG2+YG2) a parameter and is made to make a setting change of both control sensibility alphaS and the alphaT, this is based on the following reason.

Since braking/driving force control is slip ratio control by allocation of driving force or damping force, driving force or its damping force is large, the control effectiveness is large in the field in which slip ratio serves as size, and order acceleration can call a big field the field where the control effectiveness is big.

Although auxiliary rudder angle control is effective from a linearity region to a nonlinear region in the cornering power property of a tire, since the effectiveness of other control units is large, its control effectiveness is relatively large in the linearity field of a tire property, and the control effectiveness can call it the field where little order acceleration and lateral acceleration of wheel load migration are small with a big field in a nonlinear region.

therefore -- the field distinction according to the size of the control effectiveness is possible by considering as XG or (XG2+YG2) a parameter -- becoming -- XG -- or (XG2+YG2) at the time of transit with a small value By auxiliary rudder angle control sensibility alphaS being relatively made high to braking/driving force control sensibility alphaT, change of the comering power of a ring before and after following on braking/driving force control is suppressed small, and big auxiliary rudder angle control of the control effectiveness is fully employed efficiently. and XG -- or (XG2+YG2) at the time of transit with a large value By braking/driving force control sensibility alphaT being relatively made high to auxiliary rudder angle control sensibility alphaS Change of each ring slip ratio will be small suppressed by change of the wheel load accompanying auxiliary rudder angle control, big braking/driving force control of the control effectiveness will fully be employed efficiently, and optimization of the total control effectiveness by both the control units a and b is attained.

Moreover, even if consumption of total energy is restricted for the reasons of fuel consumption etc., in order that the energy expenditure by the side of equipment with the small control effectiveness may decrease by modification control of both control sensibility alphaS and alphaT, the controlled-variable limit by the side of the large equipment of the control effectiveness is prevented among both the control units a and b.

(The 1st example)

First, a configuration is explained.

Fig. 2 is a whole system chart showing the coincidence loading car of an order ring rudder angle control unit (an example of an auxiliary rudder angle control unit), an order ring driving force allocation control unit (an example of a braking/driving force control unit), and active-suspension-control equipment (an example of a wheel load allocation control unit).

As for the car with which each control system was carried, engine drive is transmitted to the rear wheels 1R and 1L on either side with the torque split four-wheel drive car of the rear-drive base through an engine 2, transmission 3, a rear propeller shaft 4, the rear differential 5, and the rear drive shafts 6R and 6L on either side.

Engine drive is transmitted to the front wheels 7R and 7L on either side through a front propeller shaft 9, the front differential 10, and the front-drive shafts 11R and 11L on either side from the transfer 8 prepared in the middle of the rear propeller shaft 4.

And between the front steering-gear equipment 12 and right-and-left rear wheel 1R which steer front wheels 7R and 7L, and 1L, the front-wheel oil pressure power cylinder 13 and the rear wheel oil pressure power cylinder 14 as a ring rudder angle control actuator before and after giving an auxiliary rudder angle to front wheels 7R and 7L and rear wheels 1R and 1L by the piston stroke by supply oil pressure are prepared.

Moreover, the oil pressure multiple disc clutch 15 as a ring driving force proportioning-control actuator before and after giving adjustable transfer torque to a front-wheel side by bonding pressure control is built in said transfer 8.

Furthermore, between the spring top of each ring, and the bottom of a spring, oil hydraulic cylinder 16FR as an active-suspension-control actuator which suppresses rocking of a car body positively by the

independent control of supply oil pressure, 16floor line, 16RR, and 16RL are prepared.
The supply oil pressure control to said front-wheel oil pressure power cylinder 13 and the rear wheel oil pressure power cylinder 14 It is what is performed by the bulb actuation control command from the rudder angle control controller 18 to front-wheel oil-pressure-control bulb 17F and rear wheel oil-pressure-control bulb 17R. Phase inversion control which aims at the model adaptation control of a yaw rate and the coexistence of control-response nature and steering stability which a detecting signal is inputted into the rudder angle control controller 18 from the front-wheel rudder angle sensor 19 and speed sensor 20 grade, for example, obtain a desired yaw rate response at the time of revolution is performed.
The supply oil pressure control to said oil pressure multiple disc clutch 15 It is what is performed by the bulb actuation control command from the driving force allocation controller 22 to the driving force proportioning-control bulb 21. The detecting signal from the forward right ring rotation sensor 23, the forward left ring rotation sensor 24, the right rear ring rotation sensor 25, the left rear ring rotation sensor 26, and lateral acceleration sensor 27 grade is inputted into the driving force allocation controller 22. rigid [from a rear drive (0:100)] in driving force allocation -- by the ring driving force proportioning control before and after the above continuously controlled to 4WD(s) (50:50) For example, by the time of start and acceleration, control which reconciles improvement in the drive engine performance and turnability is performed by reducing driving force allocation for a front wheel at the time of revolution, and considering as a rear-drive inclination, suppressing a driving wheel slip.
The supply oil pressure control to said oil hydraulic cylinder 16FR, 16floor line, 16RR, and 16RL It is what is performed by the bulb actuation control command from the suspension control controller 29 to forward right ring control bulb 28FR, forward left ring control bulb 28floor line, right rear ring control bulb 28RR, and left rear ring control bulb 28RL. The detecting signal from the vertical acceleration sensor 30, the lateral acceleration sensor 27, the order acceleration sensor 31, and car height sensor 32 grade is inputted into the suspension control controller 29. For example, bound inhibitory control of the car-body vertical direction, inhibitory control of a car-body roll, pitching inhibitory control of a car, inhibitory control of car height change, etc. are performed.
And the detecting signal from the order acceleration sensor 31 (order acceleration detection means) and the lateral acceleration sensor 27 (lateral acceleration detection means) and the switch signal from the manual switch 33 are inputted. (XG2+YG2) and (XG/YG) are distinguished for the size field of the control effectiveness according to a car condition as a parameter. It asks for the optimal auxiliary rudder angle control sensibility alphaS for the car condition at that time, driving force proportioning-control sensibility alphaT, and wheel load proportioning-control sensibility alphaR. The comprehensive control controller 34 (comprehensive control sensibility setting means) which outputs each control sensibility alphaS, alphaT, and alphaR to said each controllers 18, 22, and 29 is formed.
In addition, said manual switch 33 is a switch into which control characteristic mode is changed in order to make an intention and liking of a driver reflect, and in the example, two, the mode A of driving force property serious consideration and the mode B of turnability serious consideration, are set up.
Although the example of an order ring rudder angle control system is shown in Fig. 3 , the example of an order ring driving force allocation system is shown in the 4th drawing 4 Fig. and the example of an active-suspension-control system is shown in a 5th [**] Fig. R> Fig., all are common knowledge and detailed explanation is omitted.
Next, the fundamental concept about a control sensibility setup by this example is explained.
(**) (XG2+YG2), reason for making (XG/YG) into the parameter which classifies the size field of the control effectiveness Although it is made to carry out a modification setup of each control sensibility alphaS, alphaT, and the alphaR first as a parameter which classifies the size field of the control effectiveness for (XG2+YG2) and (XG/YG), this is based on the following reason.
- Since braking/driving force control is slip ratio control by allocation of driving force or damping force, driving force or its damping force is large, the control effectiveness is large in the field in which slip ratio serves as size, and order acceleration can call the field where the control effectiveness is big a big acceleration field or a moderation field.
- Since a wheel load proportioning control controls the load movement magnitude between right-and-left rings (or between order rings) and controls the cornering power of a tire, its control effectiveness in the field where load migration is large is large.

That is, it becomes the field where lateral acceleration and order acceleration are big. However, greater importance is attached than to order acceleration to lateral acceleration, and this is for the direction of lateral acceleration to occur regularly in many cases.

- Although auxiliary rudder angle control is effective from a linearity region to a nonlinear region in the cornering power property of a tire, since the effectiveness of other control units is large, its control effectiveness is relatively large in the linearity field of a tire property, and the control effectiveness can call it the field where little order acceleration and lateral acceleration of wheel load migration are small with a big field in a nonlinear region.

Therefore, by each control sensibility alphaS, alphaT, and alphaR, if a conceptual diagram shows the big car condition field of the control effectiveness, it will become as it is shown in Fig. 6 .

(b) problem a at the time of making control sensibility into a fixed value auxiliary rudder angle control -- being elated (XG2+YG2) -- a problem and braking/driving force control in a small field In this field, control is fundamentally unnecessary. Although power wants to become useless, to apply power (for example, oil pressure in the case of an oil pressure control) to auxiliary rudder angle control in large numbers, and to enlarge the auxiliary rudder angle control effectiveness, since a total output is restricted for the reasons of fuel consumption etc., required power cannot be obtained with an auxiliary rudder angle control unit.

It is interlocked with efficiently that braking/driving force changes, the cornering power of an order ring changes, and the control effectiveness of the auxiliary rudder angle control unit currently controlled as a thing without change of a cornering power is spoiled.

- Wheel load proportioning control Power's becoming useless and the point that the power of an auxiliary rudder angle control unit is no longer obtained are the same as that of braking/driving force control.

Efficiently, although single control of auxiliary rudder angle control is controlling by considering constant value with a steer property, a steer property changes with wheel load proportioning controls (the balance of the cornering power of order specifically changes), and the property which auxiliary rudder angle control was originally aiming at is no longer acquired.

b) a wheel load proportioning control -- being elated (XG2+YG2) -- size -- it is -- (XG/YG) -- a problem and auxiliary rudder angle control in the field of smallness Power's becoming useless and the point that the power of a wheel load allocation control unit is no longer obtained are the same as that of others.

Efficiently, since auxiliary rudder angle control was performed, the sense of the lateral force which the angle of sideslip of a tire changes and is committed into a tire, and the order force changes, and the movement magnitude of wheel load changes (if a rear wheel is turned off to opposition, it will generate so that an angle of sideslip may turn to the revolution inside, and the wheel load of a front inner ring of spiral wound gasket decreases, and the wheel load of a back outer ring of spiral wound gasket increases).

Therefore, control as the condition before control of a wheel load proportioning control changes with existence of auxiliary rudder angle control and aimed by the wheel load proportioning control cannot be performed appropriately.

- Braking/driving force control Power's becoming useless and the point that the power of a wheel load allocation control unit is no longer obtained are the same as that of others.

Efficiently, in an order ring driving force proportioning control, in order to change driving force allocation, the slip ratio of an order ring is changed. In spite of wanting to make the optimal the cornering force which controls a steer property by the wheel load proportioning control, and each ring generates, a cornering force will shift from an optimum value by fluctuation of slip ratio.

c) braking/driving force control -- being elated (XG2+YG2) -- size -- it is -- (XG/YG) -- a problem and auxiliary rudder angle control in an adult field Power's becoming useless and the point that the power of a braking/driving force control unit is no longer obtained are the same as that of others.

Efficiently, since auxiliary rudder angle control was performed, the sense of the lateral force which the angle of sideslip of a tire changes and is committed into a tire, and the order force changes, and the movement magnitude of wheel load changes (if a rear wheel is turned off to opposition, it will generate so that an angle of sideslip may turn to the revolution inside, and the wheel load of a front inner ring of spiral wound gasket decreases, and a front inner ring of spiral wound gasket races).

Therefore, the slip ratio of each ring changes with change of wheel load, and control since an order ring rotational-speed difference finally changed with existence of auxiliary rudder angle control, as it aimed cannot be performed.

- Wheel load proportioning control Power's becoming useless and the point that the power of a wheel load allocation control unit is no longer obtained are the same as that of others.
If the wheel load of one flower which exists efficiently since the wheel load proportioning control was performed decreases, the slip ratio of the tire increases, and since it races and the rotational-speed difference of an order ring changes by the existence of a wheel load proportioning control when the worst, it cannot perform control as an aim.
Next, an operation is explained.
Fig. 7 is the flow chart which shows the flow of control sensibility setting processing actuation by the comprehensive control controller 34 which sets up each control sensibility alphaS, alphaT, and alphaR, and is outputted to each controllers 18, 22, and 29, and explains each step hereafter.
At step 101, the sensor signal from the switch signal from the manual switch 33, the order acceleration sensor 31, and the lateral acceleration sensor 27 is read.
At step 102, the sum of the square of the order acceleration XG and the square of lateral acceleration YG is computed.
At step 103, it is judged for the value of (XG2+YG2) whether it is beyond a predetermined value.
By this decision, if the value of (XG2+YG2) is under a predetermined value, it will progress to step 108 and auxiliary rudder angle control sensibility alphaS, driving force proportioning-control sensibility alphaT, and wheel load proportioning-control sensibility alphaR will be set as alphaS1, alphaT1, and alphaR1, respectively.
alphaT1 and alphaR1 are set as a very small value to alphaS1, and it is made for the auxiliary rudder angle control effectiveness to become large here. For example, it is good also as alphaT1 and alphaR1**0 at alphaS1=1.
On the other hand, by decision of step 103, when the value of (XG2+YG2) is judged to be beyond a predetermined value, it progresses after step 104.
At step 104, the value of auxiliary rudder angle control sensibility alphaS and the control gain KS is computed on the auxiliary rudder angle control sensibility property map and control gain-characteristics map to a value. [being indicated within the step limit (XG2+YG2)]
In addition, although these property maps are chosen by property mode with the manual switch 33, fundamentally, auxiliary rudder angle control sensibility alphaS became so small that the value of (XG2+YG2) becomes large (the lower right is **), and the control gain KS is set as the property which becomes so large that the value of (XG2+YG2) becomes large (upward slant to the right).
The value of (XG/YG) is computed at step 105.
At step 106, the value of driving force allocation basic control sensibility alphaTO and wheel load allocation basic control sensibility alphaRO is computed on the driving force proportioning-control sensibility property map and wheel load proportioning-control sensibility property map to a value [being indicated within the step limit (XG/YG)].
In addition, although these property maps are chosen by the property mode by the manual switch 33, fundamentally, driving force allocation basic control sensibility alphaTO became so large that the value of (XG/YG) becomes large (upward slant to the right), and wheel load allocation basic control sensibility alphaRO is set as the property which becomes so small that the value of (XG/YG) becomes large (the lower right is **).
At step 107, basic control sensibility alphaTO and alphaRO which were calculated at said step 106 are amended by the following formula, and driving force proportioning-control sensibility alphaT and wheel load proportioning-control sensibility alphaR are computed.
alpha T=alpha TO-KS alpha R=alpha RO-KS At step 109, each control sensibility alphaS obtained at step 104 and step 107, or step 108, alphaT, and alphaR are outputted to the rudder angle control controller 18, the driving force allocation controller 22, and the suspension control controller 29, respectively.
Based on a setup of the above each control sensibility alphaS, alphaT, and alphaR, the following control is performed by each controllers 18, 22, and 29.
By the rudder angle control controller 18, as shown in the following formula, the value which multiplied auxiliary rudder angle control sensibility alphaS by the basic control rudder angles fsf and fsr is made into front-wheel auxiliary rudder angle desired value deltaF* and rear wheel auxiliary rudder angle desired value deltaR*, and the command signal with which this desired value deltaF* and deltaR* are obtained is

outputted to front-wheel rudder angle control bulb 17F and rear wheel rudder angle control bulb 17R.
deltaF*=alphaS-fsf (theta, V)
deltaR*=alphaS-fsr (theta, V)
By the driving force allocation controller 22, as shown in the following formula, the value which multiplied driving force proportioning-control sensibility alphaT by the basic front-wheel side driving force allocation rate fT is made into driving force allocation front-wheel rate desired value TF*, and the command signal with which this desired value TF* is obtained is outputted to the driving force proportioning-control bulb 21.
TF*=alphaT-fT (delta N, YG)
However, deltaN is an order ring rotational-speed difference, asks for the rear wheel rotational speed Nr and the front-wheel rotational speed Nf with the signal from each rotation sensors 23, 24, 25, and 26, and is obtained by the degree type which takes these differences.
deltaN=Nr-Nf By the suspension control controller 29, as shown in the following formula, the value which multiplied wheel load proportioning-control sensibility alphaR by the basic wheel load allocation rate fR is made into wheel load allocation rate desired value RS*.
RS*=alphaR-fR (ZG, XG, YG, S)
When ring rudder angle control as explained above, before and after being equivalent to the example of the comprehensive control unit of the auxiliary rudder angle and braking/driving force which are this invention, and an order ring driving force proportioning control are seen, the effectiveness of enumerating below is demonstrated.
** As the field distinction according to the size of the control effectiveness is attained by making XG2+YG2 into a parameter and it is shown in the property map of Fig. 8 At the time of transit with the small value of (XG2+YG2) By auxiliary rudder angle control sensibility alphaS being relatively made high to driving force proportioning-control sensibility alphaT, change of the cornering power of a ring before and after following on a driving force proportioning control is suppressed small, and big order ring rudder angle control of the control effectiveness is fully employed efficiently.
Moreover, by driving force proportioning-control sensibility alphaT being relatively made high to auxiliary rudder angle control sensibility alphaS, change of each ring slip ratio will be small suppressed by change of the wheel load allocation accompanying order ring rudder angle control, and the big driving force proportioning control of the control effectiveness will fully be employed efficiently at the time of transit with the large value of (XG2+YG2).
That is, optimization of the total control effectiveness by both the control units of an auxiliary rudder angle and driving force allocation is attained.
** Even if consumption of total energy is restricted for the reasons of fuel consumption etc., in order that the energy expenditure by the side of equipment with the small control effectiveness may decrease by modification control of both control sensibility alphaS and alphaT, the controlled-variable limit by the side of the large equipment of the control effectiveness is prevented among both the control units of an auxiliary rudder angle and driving force allocation.
** The manual switch 33 is formed, and since selection of the driving force property serious consideration mode A or the turnability serious consideration mode B was enabled as shown in Figs. 8 and 9, the engine performance of loading equipment can be pulled out corresponding to liking, a transit road surface, etc. of a driver.
(The 2nd example)
Next, the comprehensive control unit of the auxiliary rudder angle of the 2nd example and braking/driving force equivalent to invention according to claim 1 is explained.
Although it showed the example which determines the size of control sensibility by both order acceleration XG and lateral acceleration YG since the 1st example was a system containing a wheel load allocation control unit As this 2nd example is the car with which two equipments of an auxiliary rudder angle control unit and a braking/driving force control unit were carried in coincidence and indicated to claim 1 It is the example which detects only the order acceleration XG and set up auxiliary rudder angle control sensibility alphaS and driving force proportioning-control sensibility alphaT, without detecting lateral acceleration YG. In the 1st example equipment, it becomes the system by which the suspension control system was omitted in configuration, and since it is [other configurations] the same, explanation is omitted.
Next, Fig. 10 is the flow chart which shows the flow of the control sensibility setting processing actuation

performed by the comprehensive control controller 34 of the 2nd example, and explains each step hereafter.
At step 201, the order acceleration XG is read from the order acceleration sensor 31.
At step 202, auxiliary rudder angle control sensibility alphaS and driving force proportioning-control sensibility alphaT are determined according to the control sensibility property map indicated within the SUTE limit based on the order acceleration XG.
That is, in an after [low forward] acceleration region, it considers as a value with auxiliary rudder angle control sensibility alphaS higher than driving force proportioning-control sensibility alphaT, and considers as a value with driving force proportioning-control sensibility alphaT higher than auxiliary rudder angle control sensibility alphaS in an after [high forward] acceleration region.
At step 203, both control sensibility alphaS determined at step 202 and alphaT are outputted to the rudder angle control controller 18 and the driving force allocation controller 22.
Therefore, optimization of the total control effectiveness by both control units can be attained, preventing that a controlled variable is restricted by the large equipment side of the control effectiveness at the time of coincidence actuation of both control units like the 1st example.
As mentioned above, although the example has been explained based on a drawing, a concrete configuration is not restricted to this example, and even if the design change in the range which does not deviate from the summary of this invention etc. occurs, it is included in this invention.
For example, although the example showed the example of the property (Fig. 8) that control sensibility alphaS and alphaT cross As both properties do not necessarily need to cross and it is shown in Fig. 9 , when the property graph to (XG2+YG2) (alphaT/alphaS) is indicated, It is contained in this invention, if auxiliary rudder angle control sensibility alphaS and driving force proportioning-control sensibility alphaT are set up so that the value of, so that the value of (XG2+YG2) becomes large (alphaT/alphaS) may become large. That is, a claim is satisfied, even when each control sensibility property map is convex and it is convex, if it fulfills that the graph of (alphaT/alphaS) is a graph of an upward-slant-to-the-right property.
Moreover, in this example, although the system containing a wheel load allocation control unit has been explained, of course, it is applicable also to the car with which the wheel load allocation control unit is not carried, and can apply to the car in which the auxiliary rudder angle control unit and the braking/driving force control unit were carried similarly at least.
Moreover, although both examples showed the example which carries out rudder angle control of the order ring as an auxiliary rudder angle control unit, you may be equipment which carries out auxiliary rudder angle control only of a rear wheel or the front wheel.
Moreover, as a braking/driving force control unit, although the example of order ring driving force allocation equipment was shown, you may be the antilock braking system which controls the damping force of the traction control equipment which controls directly a right-and-left driving force allocation control unit and the driving force of each ring, or each ring.
(Effect of the invention)
If it is in invention according to claim 1 as explained above In the comprehensive control unit of the car with which the auxiliary rudder angle control unit and the braking/driving force control unit were carried in coincidence Order acceleration is distinguished for the car condition field where the control effectiveness of auxiliary rudder angle control is big, and the car condition field where the control effectiveness of braking/driving force control is big as a parameter. The effectiveness that optimization of the total control effectiveness by both control units can be attained is acquired preventing that a controlled variable is restricted by the large equipment side of the control effectiveness at the time of coincidence actuation of both control units, since it considered as a means to change control sensibility according to the size of the control effectiveness.
In the comprehensive control unit of the car with which the auxiliary rudder angle control unit and the braking/driving force control unit were carried in coincidence if it was in invention according to claim 2 The sum of the square of order acceleration and the square of lateral acceleration is distinguished for the car condition field where the control effectiveness of auxiliary rudder angle control is big, and the car condition field where the control effectiveness of braking/driving force control is big as a parameter. The effectiveness that optimization of the total control effectiveness by both control units can be attained is acquired preventing that a controlled variable is restricted by the large equipment side of the control

effectiveness at the time of coincidence actuation of both control units, since it considered as a means to change control sensibility according to the size of the control effectiveness.

[Translation done.]

TECHNICAL FIELD

(Field of the Invention)
This invention relates to the comprehensive control unit of an auxiliary rudder angle and braking/driving force.

[Translation done.]

PRIOR ART

(Prior art)
The contents which the equipment indicated by JP,59-77968,A, for example as a rear wheel rudder angle control unit which is an example of a former and auxiliary rudder angle control unit is known, **** a rear wheel to opposition when [this] the time of the low vehicle speed or a front-wheel steering angle is conventionally large to a source, **** a rear wheel to an inphase when the time of the high vehicle speed or a front-wheel steering angle is small, and raise controllability ability are shown.
Moreover, conventionally, as a driving force allocation control unit of the four-wheel drive car which is an example of a braking/driving force control unit, the equipment indicated by JP,61-157437,A is known, for example, the driving force allocation by the side of a coupled driving wheel is increased to a source at the time of driving wheel slip generating, conventionally [this], driving force allocation is controlled to a four-flower driving direction, and the contents which raise the drive engine performance and transit stability in the time of sudden start and acceleration etc. are shown in it.

[Translation done.]

EFFECT OF THE INVENTION

(Effect of the invention)
If it is in invention according to claim 1 as explained above In the comprehensive control unit of the car with which the auxiliary rudder angle control unit and the braking/driving force control unit were carried in coincidence Order acceleration is distinguished for the car condition field where the control effectiveness of auxiliary rudder angle control is big, and the car condition field where the control effectiveness of braking/driving force control is big as a parameter. The effectiveness that optimization of the total control effectiveness by both control units can be attained is acquired preventing that a controlled variable is restricted by the large equipment side of the control effectiveness at the time of coincidence actuation of both control units, since it considered as a means to change control sensibility according to the size of the control effectiveness.
In the comprehensive control unit of the car with which the auxiliary rudder angle control unit and the braking/driving force control unit were carried in coincidence if it was in invention according to claim 2 The sum of the square of order acceleration and the square of lateral acceleration is distinguished for the car condition field where the control effectiveness of auxiliary rudder angle control is big, and the car condition field where the control effectiveness of braking/driving force control is big as a parameter. The effectiveness that optimization of the total control effectiveness by both control units can be attained is acquired preventing that a controlled variable is restricted by the large equipment side of the control effectiveness at the time of coincidence actuation of both control units, since it considered as a means to change control sensibility according to the size of the control effectiveness.

[Translation done.]

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TECHNICAL PROBLEM

(Object of the Invention)
By however, the case where the above-mentioned rear wheel rudder angle control unit and the driving force allocation control unit of a four-wheel drive car are carried in coincidence at one car Come out, respectively and rear wheel rudder angle control sensibility and driving force proportioning-control sensibility are set up uniquely. When it considers as the configuration which carries out mutually-independent based on setting sensibility, and performs rear wheel rudder angle control and a driving force proportioning control, Although the car condition field where the control effectiveness of auxiliary rudder angle control is big originally differs from the car condition field where the control effectiveness of braking/driving force control is big, since this point is not taken into consideration at all, the thing with the optimal total control effectiveness by both control units does not become.
Moreover, by the car in which two or more control units are carried in this way, when rear wheel rudder angle control and a driving force proportioning control are performed to coincidence, while a controlled variable turns into the same controlled variable as the case where it is carried independently even if it is in the small car condition of one control effectiveness and total energy expenditure serves as size, when consumption of total energy is restricted for the reasons of fuel consumption etc., the controlled variable of a side with the large control effectiveness may be restricted.
Then, although it can consider carrying out cooperative control, or performing control with which parts for other performance degradation are compensated by one control modification, and making mutual control link in order to only raise a certain engine performance, in this case, only to the specific engine performance, effectiveness does not pass to be obtained and cannot attain optimization of the total control effectiveness.
This invention was made paying attention to the above problems, and it makes it a technical problem to attain optimization of the total control effectiveness by both control units in the comprehensive control unit of the car with which the auxiliary rudder angle control unit and the braking/driving force control unit were carried in coincidence, preventing that a controlled variable is restricted by the large equipment side of the control effectiveness at the time of coincidence actuation of both control units.

[Translation done.]

MEANS

(The means for solving a technical problem)
In order to solve the above-mentioned technical problem, it considered as a means to distinguish the car condition field where the control effectiveness of auxiliary rudder angle control is big, and the car condition field where the control effectiveness of braking/driving force control is big with the same parameter which contains order acceleration at least, and to change control sensibility according to the size of the control effectiveness at the comprehensive control unit of the auxiliary rudder angle of this invention, and braking/driving force.
As shown in the Fig. corresponding to the claim of Fig. 1 , namely, in invention according to claim 1 The auxiliary rudder angle control unit a which controls one [at least] rudder angle of a front wheel or a rear wheel at the time of front-wheel steering The braking/driving force control unit b which controls either [at least] the damping force of each ring, or driving force When the value multiplied by the amount of basic control is defined as control sensibility by the operation expression which obtains the acceleration detection means c before and after detecting the acceleration XG before and after acting on a car, and a target controlled variable, When the value of an order acceleration detection value is small, braking/driving force control sensibility alphaT is greatly set up for auxiliary rudder angle control sensibility alphaS small. It is characterized by having a comprehensive control sensibility setting means e to make small auxiliary rudder angle control sensibility alphaS, and to set up braking/driving force control sensibility alphaT greatly as the value of an order acceleration detection value becomes large.
Moreover, the auxiliary rudder angle control unit a which controls one [at least] rudder angle of a front wheel or a rear wheel by invention according to claim 2 at the time of front-wheel steering The braking/driving force control unit b which controls either [at least] the damping force of each ring, or driving force When the value multiplied by the amount of basic control is defined as control sensibility by the operation expression which obtains the acceleration detection means c before and after detecting the acceleration XG before and after acting on a car, a lateral acceleration detection means d to detect the lateral acceleration YG which acts on a car, and a target controlled variable, Calculate the sum (XG2+YG2) of the square of an order acceleration detection value, and the square of a lateral acceleration detection value, and when the operation value of the sum (XG2+YG2) of a square is below a predetermined value While setting auxiliary rudder angle control sensibility alphaS as big constant value, when braking/driving force control sensibility alphaT is set as small constant value and the operation value of the sum (XG2+YG2) of a square exceeds a predetermined value The ratio (alphaT/alphaS) of an acceleration detection value before and after receiving a lateral acceleration detection value is calculated. When the value of the calculated ratio (alphaT/alphaS) is small, braking/driving force control sensibility alphaT is greatly set up for auxiliary rudder angle control sensibility alphaS small. It is characterized by having a comprehensive control sensibility setting means e to make small auxiliary rudder angle control sensibility alphaS, and to set up braking/driving force control sensibility alphaT greatly as the value of the calculated ratio (alphaT/alphaS) becomes large.
(Work for)
When the value of an acceleration detection value when the value multiplied by the amount of basic control is defined as control sensibility by the operation expression which obtains a target controlled variable in the comprehensive control sensibility setting means e at the time of car transit if it is in invention according to claim 1, before and after detecting from the order acceleration detection means c is small, auxiliary rudder-angle control sensibility alpha S is set up greatly, and braking/driving-force control sensibility alpha T is set

up small. And auxiliary rudder angle control sensibility alphaS is small set up as the value of an order acceleration detection value becomes large, and braking/driving force control sensibility alphaT is set up greatly.
Moreover, if it is in invention according to claim 2 at the time of car transit When the value multiplied by the amount of basic control is defined as control sensibility in the comprehensive control sensibility setting means e by the operation expression which obtains a target controlled variable, The sum (XG2+YG2) of the square of an order acceleration detection value and the square of a lateral acceleration detection value calculates, and when the operation value of the sum (XG2+YG2) of a square is below a predetermined value, while auxiliary rudder angle control sensibility alphaS is set as big constant value, braking/driving force control sensibility alphaT is set as small constant value. and when the operation value of the sum (XG2+YG2) of a square exceeds a predetermined value The ratio (alphaT/alphaS) of an acceleration detection value before and after receiving a lateral acceleration detection value calculates. When the value of this calculated ratio (alphaT/alphaS) is small, auxiliary rudder angle control sensibility alphaS is set up greatly. Auxiliary rudder angle control sensibility alphaS is set up small, and braking/driving force control sensibility alphaT is greatly set up as braking/driving force control sensibility alphaT is set up small and the value of the calculated ratio (alphaT/alphaS) becomes large.
That is, although it considers as XG or (XG2+YG2) a parameter and is made to make a setting change of both control sensibility alphaS and the alphaT, this is based on the following reason.
Since braking/driving force control is slip ratio control by allocation of driving force or damping force, driving force or its damping force is large, the control effectiveness is large in the field in which slip ratio serves as size, and order acceleration can call a big field the field where the control effectiveness is big.
Although auxiliary rudder angle control is effective from a linearity region to a nonlinear region in the cornering power property of a tire, since the effectiveness of other control units is large, its control effectiveness is relatively large in the linearity field of a tire property, and the control effectiveness can call it the field where little order acceleration and lateral acceleration of wheel load migration are small with a big field in a nonlinear region.
therefore -- the field distinction according to the size of the control effectiveness is possible by considering as XG or (XG2+YG2) a parameter -- becoming -- XG -- or (XG2+YG2) at the time of transit with a small value By auxiliary rudder angle control sensibility alphaS being relatively made high to braking/driving force control sensibility alphaT, change of the cornering power of a ring before and after following on braking/driving force control is suppressed small, and big auxiliary rudder angle control of the control effectiveness is fully employed efficiently. and XG -- or (XG2+YG2) at the time of transit with a large value By braking/driving force control sensibility alphaT being relatively made high to auxiliary rudder angle control sensibility alphaS Change of each ring slip ratio will be small suppressed by change of the wheel load accompanying auxiliary rudder angle control, big braking/driving force control of the control effectiveness will fully be employed efficiently, and optimization of the total control effectiveness by both the control units a and b is attained.
Moreover, even if consumption of total energy is restricted for the reasons of fuel consumption etc., in order that the energy expenditure by the side of equipment with the small control effectiveness may decrease by modification control of both control sensibility alphaS and alphaT, the controlled-variable limit by the side of the large equipment of the control effectiveness is prevented among both the control units a and b.

[Translation done.]

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EXAMPLE

(The 1st example)
First, a configuration is explained.
Fig. 2 is a whole system chart showing the coincidence loading car of an order ring rudder angle control unit (an example of an auxiliary rudder angle control unit), an order ring driving force allocation control unit (an example of a braking/driving force control unit), and active-suspension-control equipment (an example of a wheel load allocation control unit).
As for the car with which each control system was carried, engine drive is transmitted to the rear wheels 1R and 1L on either side with the torque split four-wheel drive car of the rear-drive base through an engine 2, transmission 3, a rear propeller shaft 4, the rear differential 5, and the rear drive shafts 6R and 6L on either side.
Engine drive is transmitted to the front wheels 7R and 7L on either side through a front propeller shaft 9, the front differential 10, and the front-drive shafts 11R and 11L on either side from the transfer 8 prepared in the middle of the rear propeller shaft 4.
And between the front steering-gear equipment 12 and right-and-left rear wheel 1R which steer front wheels 7R and 7L, and 1L, the front-wheel oil pressure power cylinder 13 and the rear wheel oil pressure power cylinder 14 as a ring rudder angle control actuator before and after giving an auxiliary rudder angle to front wheels 7R and 7L and rear wheels 1R and 1L by the piston stroke by supply oil pressure are prepared.
Moreover, the oil pressure multiple disc clutch 15 as a ring driving force proportioning-control actuator before and after giving adjustable transfer torque to a front-wheel side by bonding pressure control is built in said transfer 8.
Furthermore, between the spring top of each ring, and the bottom of a spring, oil hydraulic cylinder 16FR as an active-suspension-control actuator which suppresses rocking of a car body positively by the independent control of supply oil pressure, 16floor line, 16RR, and 16RL are prepared.
The supply oil pressure control to said front-wheel oil pressure power cylinder 13 and the rear wheel oil pressure power cylinder 14 It is what is performed by the bulb actuation control command from the rudder angle control controller 18 to front-wheel oil-pressure-control bulb 17F and rear wheel oil-pressure-control bulb 17R. Phase inversion control which aims at the model adaptation control of a yaw rate and the coexistence of control-response nature and steering stability which a detecting signal is inputted into the rudder angle control controller 18 from the front-wheel rudder angle sensor 19 and speed sensor 20 grade, for example, obtain a desired yaw rate response at the time of revolution is performed.
The supply oil pressure control to said oil pressure multiple disc clutch 15 It is what is performed by the bulb actuation control command from the driving force allocation controller 22 to the driving force proportioning-control bulb 21. The detecting signal from the forward right ring rotation sensor 23, the forward left ring rotation sensor 24, the right rear ring rotation sensor 25, the left rear ring rotation sensor 26, and lateral acceleration sensor 27 grade is inputted into the driving force allocation controller 22. rigid [from a rear drive (0:100)] in driving force allocation -- by the ring driving force proportioning control before and after the above continuously controlled to 4WD(s) (50:50) For example, by the time of start and acceleration, control which reconciles improvement in the drive engine performance and turnability is performed by reducing driving force allocation for a front wheel at the time of revolution, and considering as a rear-drive inclination, suppressing a driving wheel slip.
The supply oil pressure control to said oil hydraulic cylinder 16FR, 16floor line, 16RR, and 16RL It is what

is performed by the bulb actuation control command from the suspension control controller 29 to forward right ring control bulb 28FR, forward left ring control bulb 28floor line, right rear ring control bulb 28RR, and left rear ring control bulb 28RL. The detecting signal from the vertical acceleration sensor 30, the lateral acceleration sensor 27, the order acceleration sensor 31, and car height sensor 32 grade is inputted into the suspension control controller 29. For example, bound inhibitory control of the car-body vertical direction, inhibitory control of a car-body roll, pitching inhibitory control of a car, inhibitory control of car height change, etc. are performed.
And the order acceleration sensor 31

[Translation done.]

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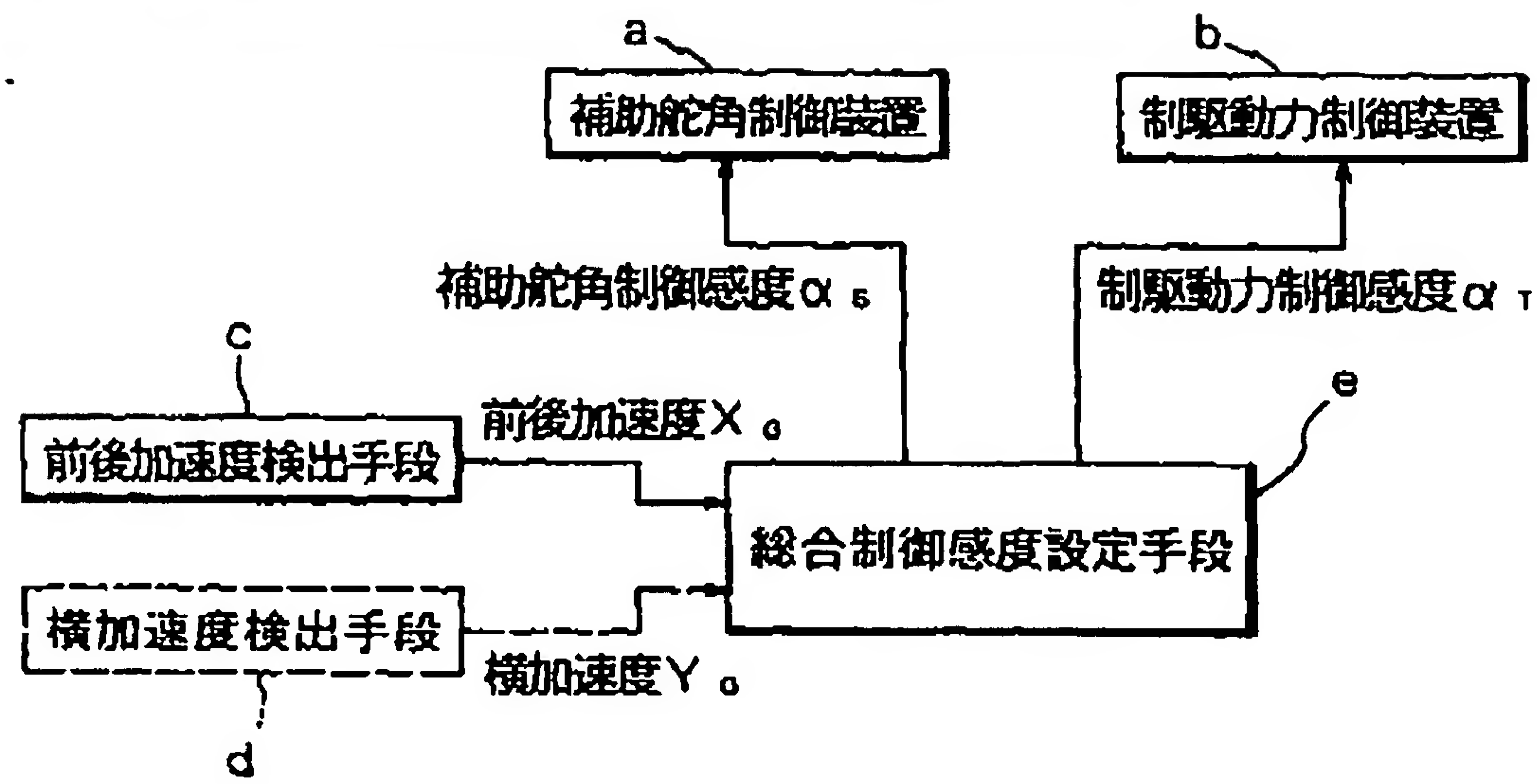
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
The Fig. corresponding to a claim showing [1] the comprehensive control unit of the auxiliary rudder angle of this invention, and braking/driving force, The whole system chart showing [2] the coincidence loading car of an order ring rudder angle control unit (an example of an auxiliary rudder angle control unit), an order ring driving force allocation control unit (an example of a braking/driving force control unit), and active-suspension-control equipment (an example of a wheel load allocation control unit), Drawing showing [3] the example of an order ring rudder angle control unit, drawing showing [4] the example of an order ring driving force allocation control unit, Drawing showing [5] the example of active-suspension-control equipment, the field conceptual diagram showing [6] the big car condition field of the control effectiveness by each control, The flow chart with which Fig. 7 shows the flow of control sensibility setting processing actuation by the comprehensive control controller of the 1st example, It is the flow chart with which the property map Fig. [as opposed to the value of (XG2+YG2) in Fig. 8] of auxiliary rudder angle control sensibility and driving force proportioning-control sensibility and Fig. 9 show a control sensibility ratio property graphical representation, and Fig. 10 shows the flow of control sensibility setting processing actuation by the comprehensive control controller of the 2nd example.
a .... Auxiliary rudder angle control unit
b .... Braking/driving force control unit
c .... Order acceleration detection means
d .... Lateral acceleration detection means
e .... Comprehensive control sensibility setting means

[Translation done.]

Drawing selection Drawing 1



[Translation done.]

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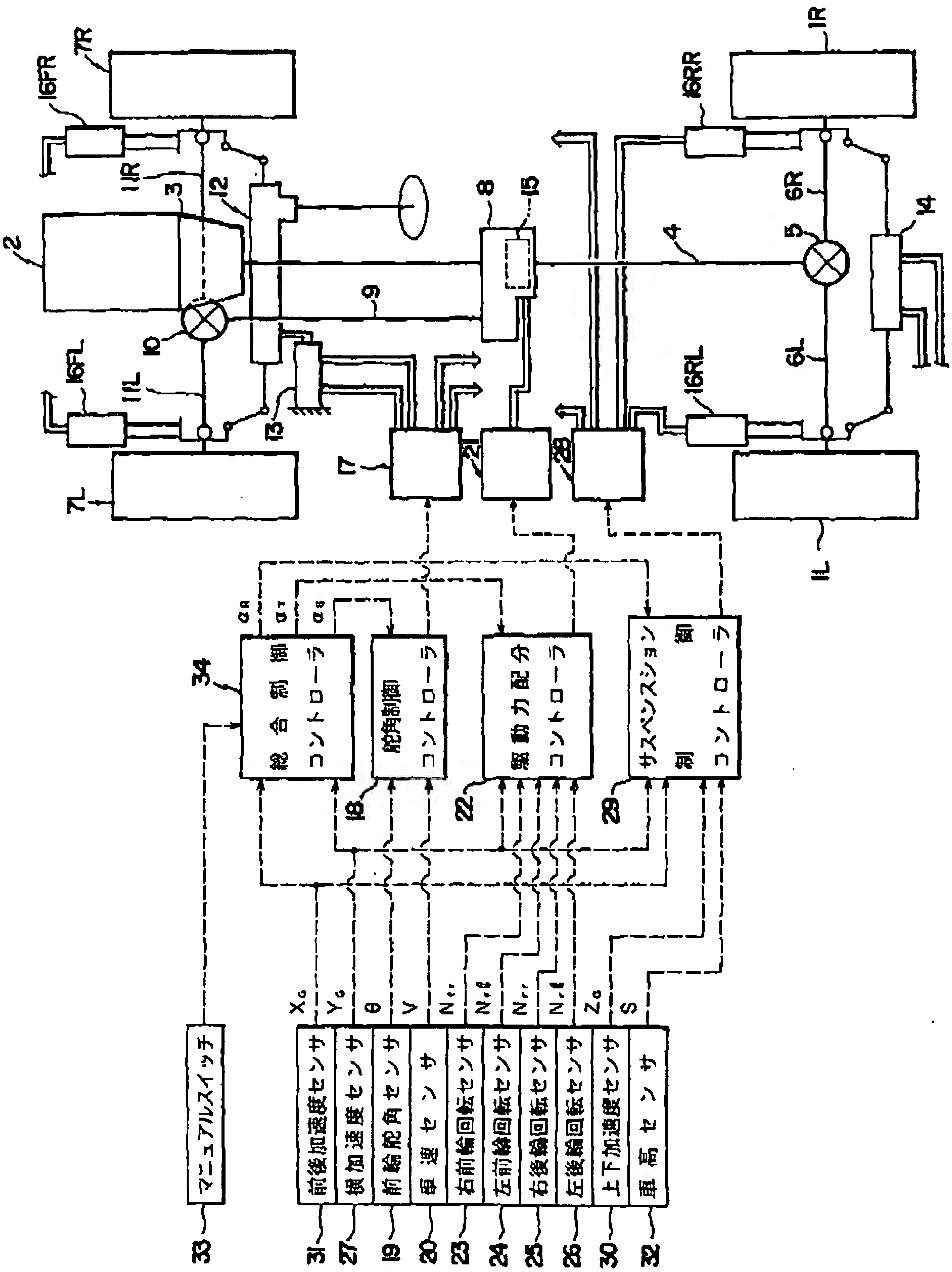

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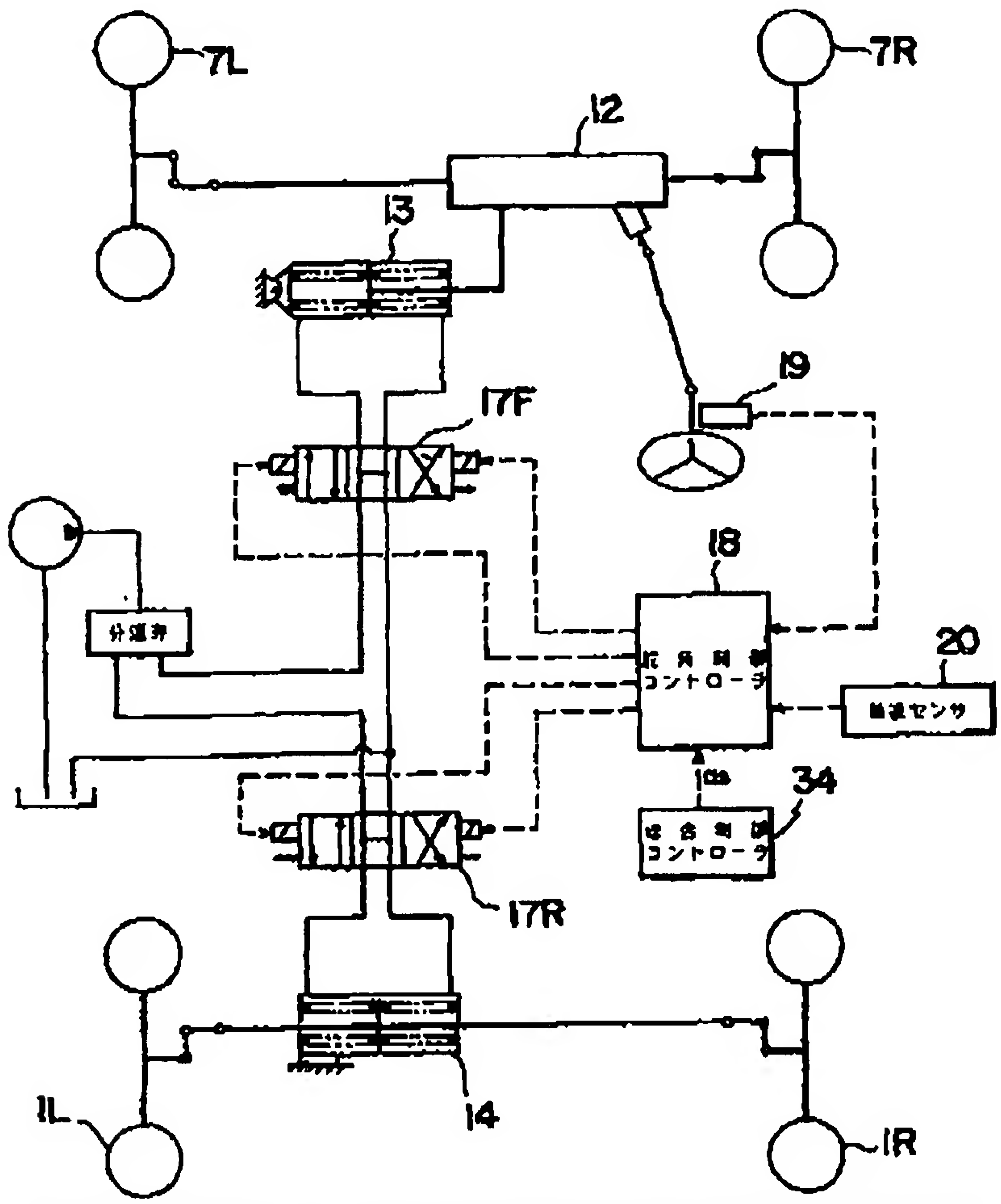
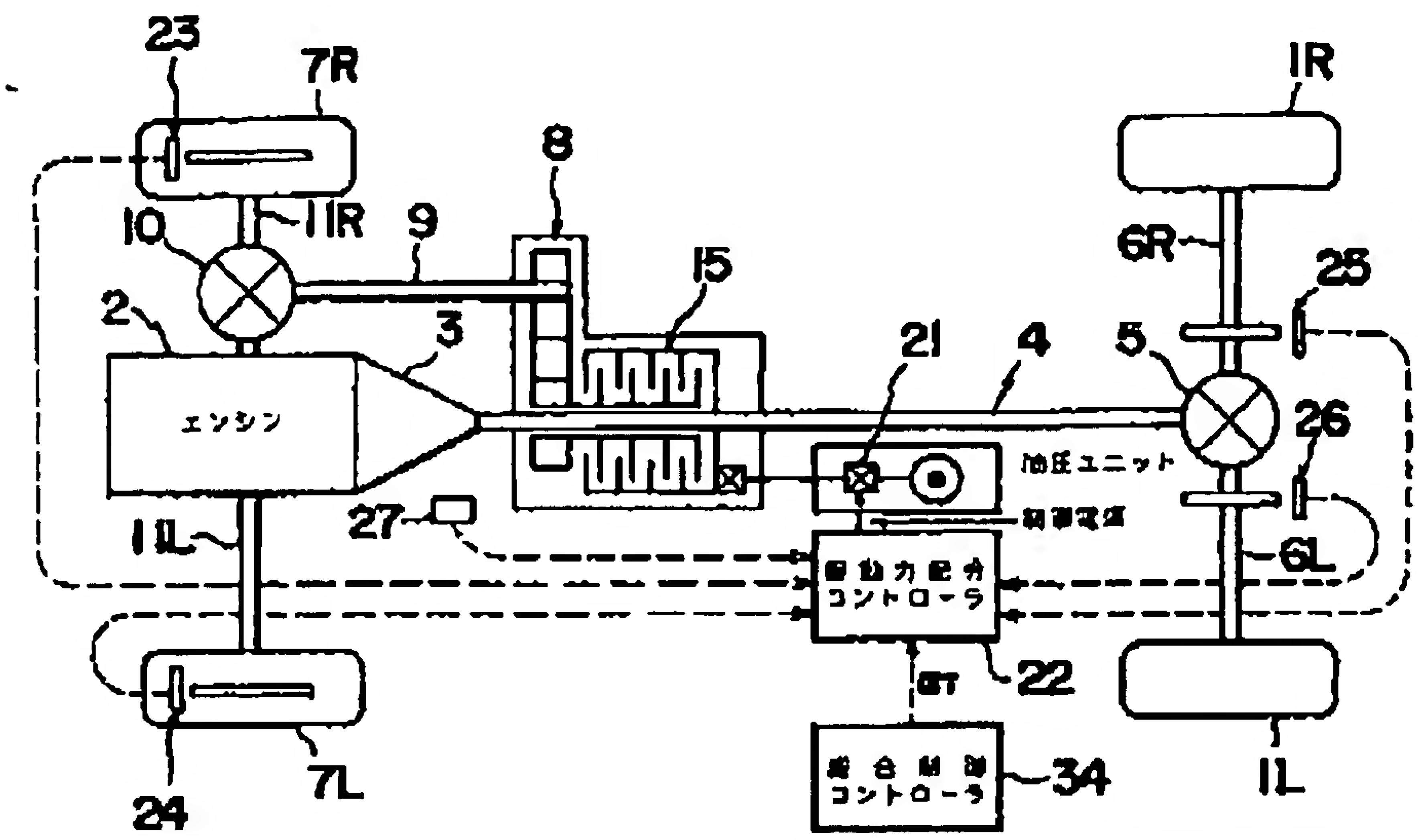


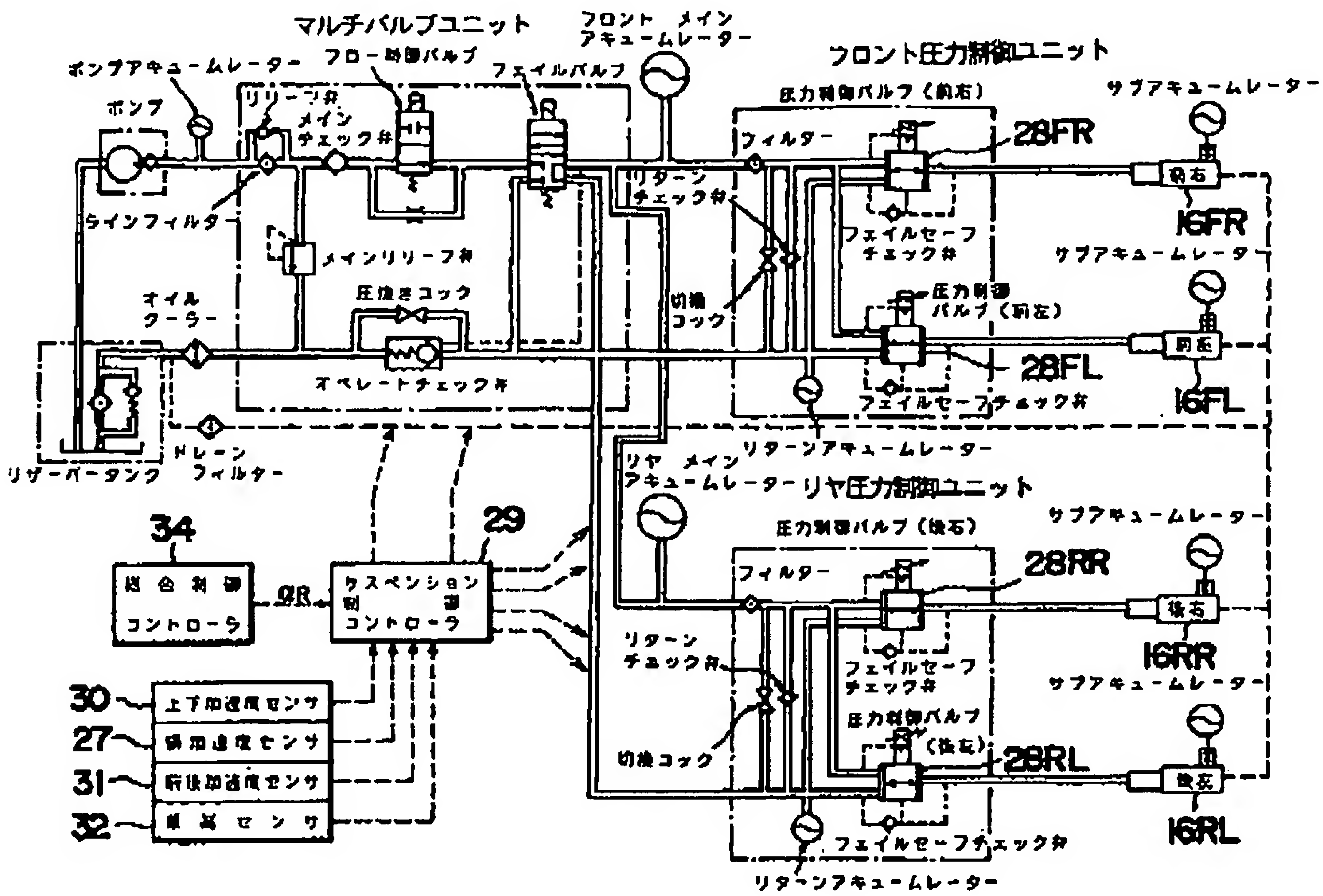
[Translation done.]

Drawing selection Drawing 4



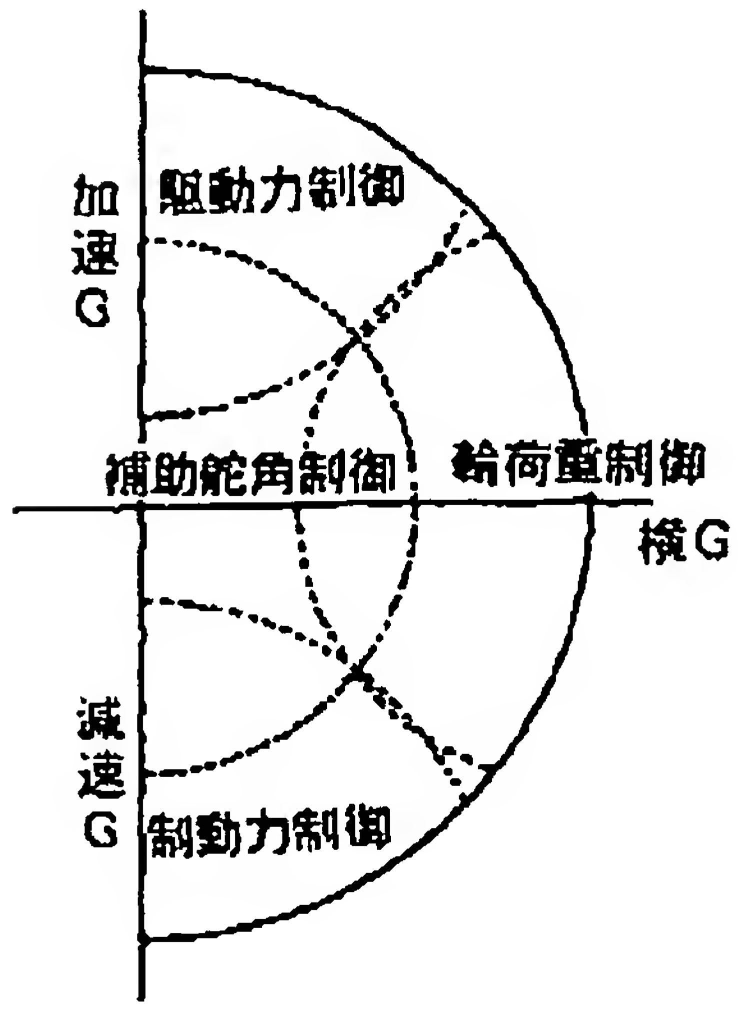
[Translation done.]

Drawing selection Drawing 5



[Translation done.]

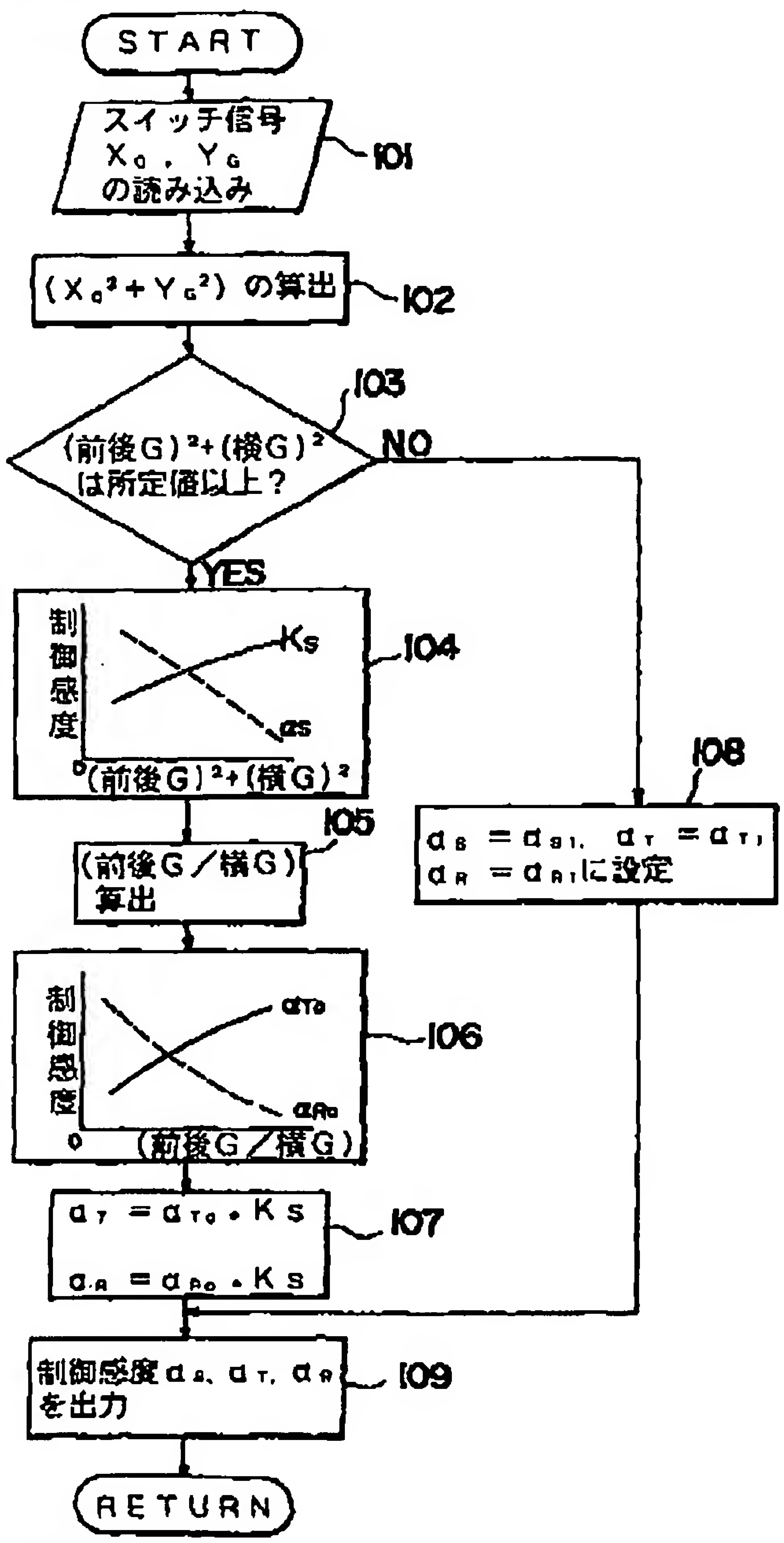
Drawing selection Drawing 6



[Translation done.]

JP3079538, B [Fig. 7]

Drawing selection Drawing 7



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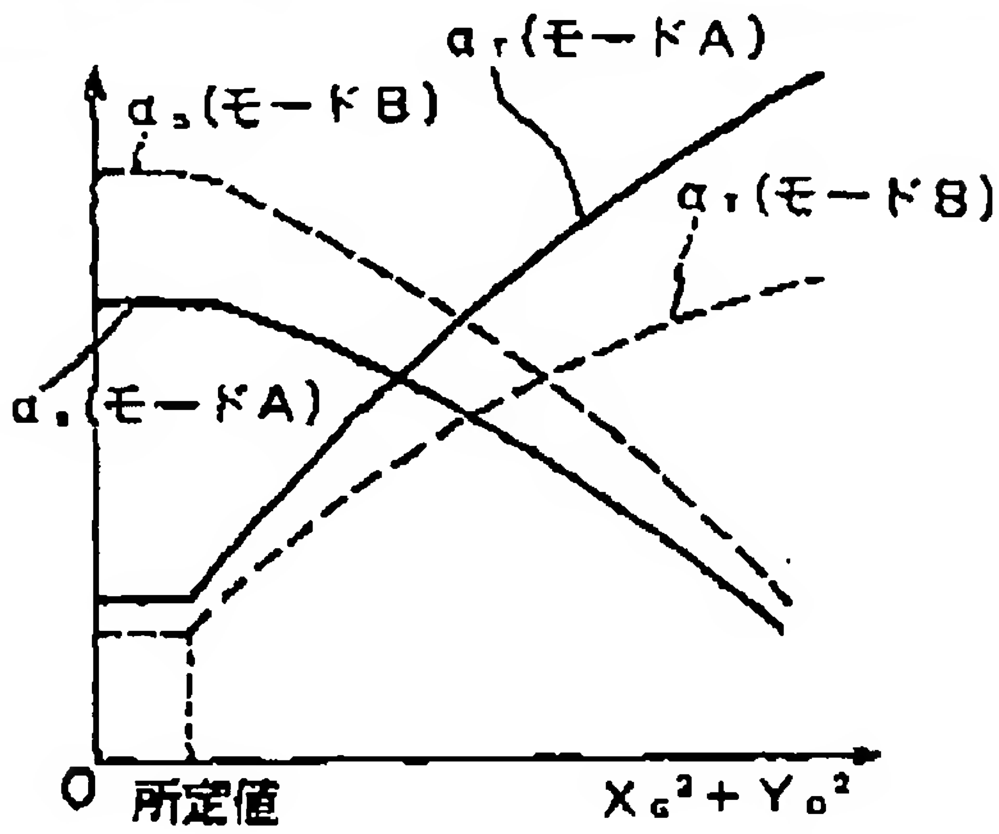
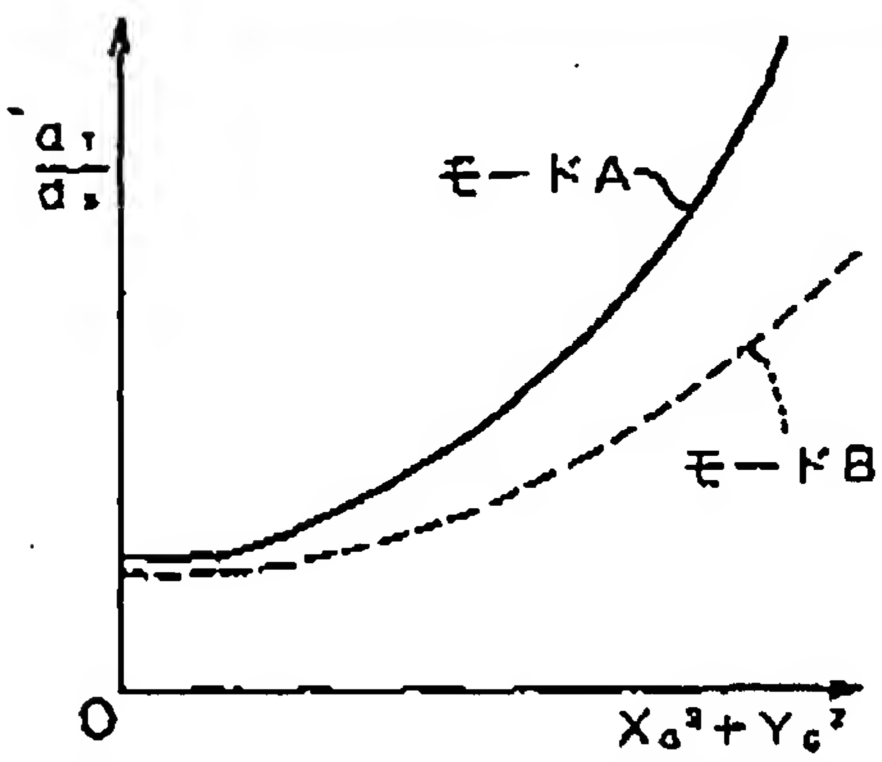
Drawing selection Drawing 8



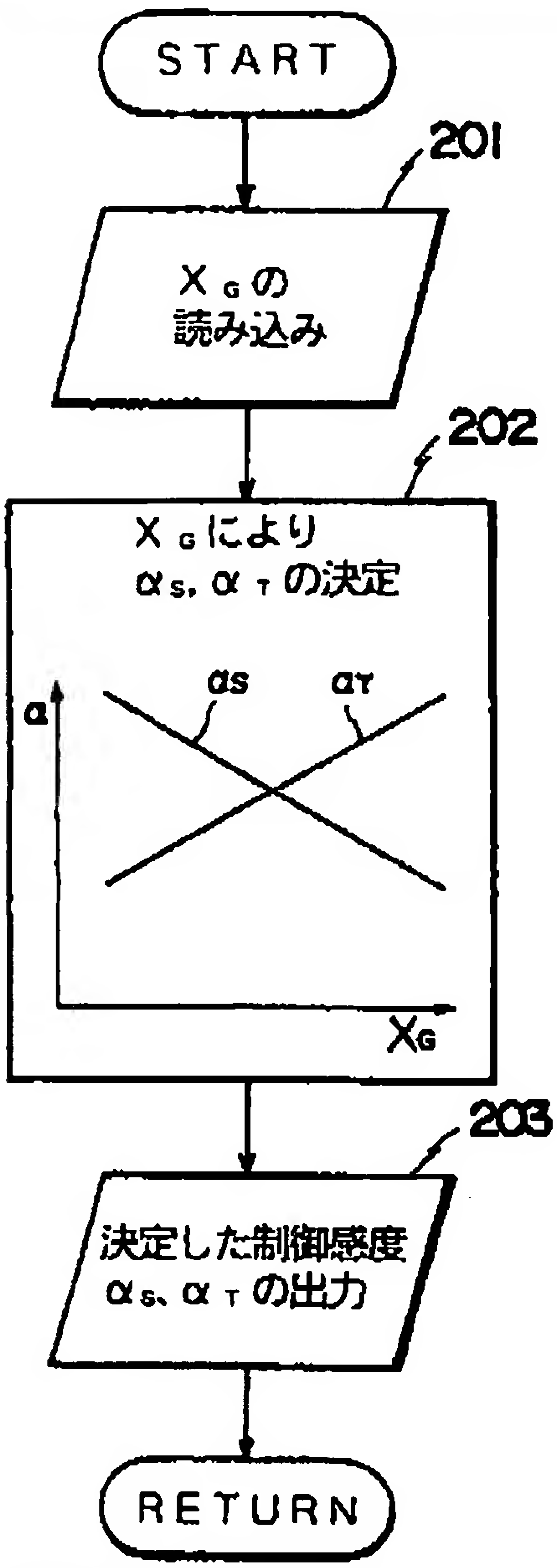
[Translation done.]

Drawing selection Drawing 9



[Translation done.]

Drawing selection Drawing 10



[Translation done.]